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G5C CJE

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(56) Documents Cited

GB 2289707 A

JP 080022259 A

US 5503583 A

US 5202677 A

US 4142782 A

US 4028118 A

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(54) Abstract Title

Thermochromic display

(57) The thermochromic display, particularly for use as road signs warning of icy conditions, comprises a first region 12 and a second region 14, the first region having a first colour and the second region having a thermochromic paint applied thereto, the colour of which changes from a second colour to a third colour at a temperature threshold, wherein the thermochromic paint does not comprise liquid crystals. The thermochromic paint preferably displays the second colour above the temperature threshold and the third colour below the temperature threshold. The paint may comprise one or more organic compounds and preferably comprises one or more electron donating chromatic organic compounds, one or more compounds having a phenolic hydroxyl group and one or more compounds selected from the group of higher aliphatic monovalent alcohols, and may further comprise a compound selected from the group of higher aliphatic monovalent acid alcohol esters. The threshold temperature may be in the range of -5 to 5 degrees centigrade and either the second or the third colour may be the same as the first colour. The second region may be in the shape of a written message or a logo or motif. The first region may also be coated in thermochromic paint that changes colour from the first colour to a fourth colour at a temperature threshold. The first colour may be the same as the second colour and the third and fourth colours may be contrasting colours. The display is preferably provided on a board made from a material with high thermal conductivity and be provided with a transparent coating and means for illuminating the display.

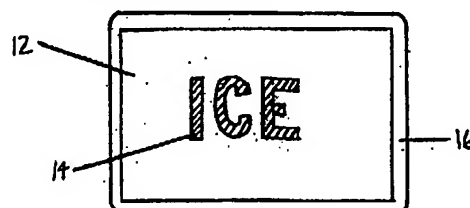


FIGURE 1a

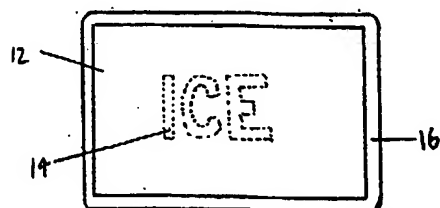


FIGURE 1b

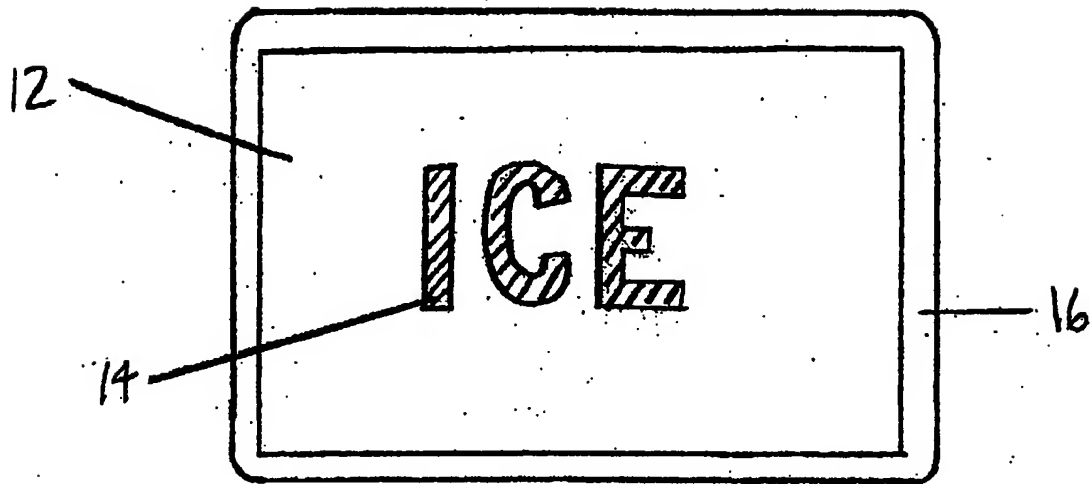


FIGURE 1a

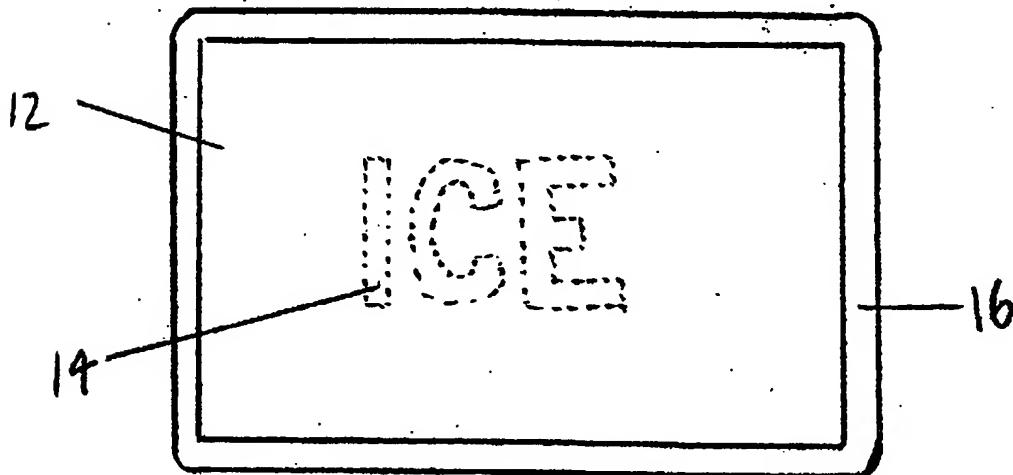


FIGURE 1b

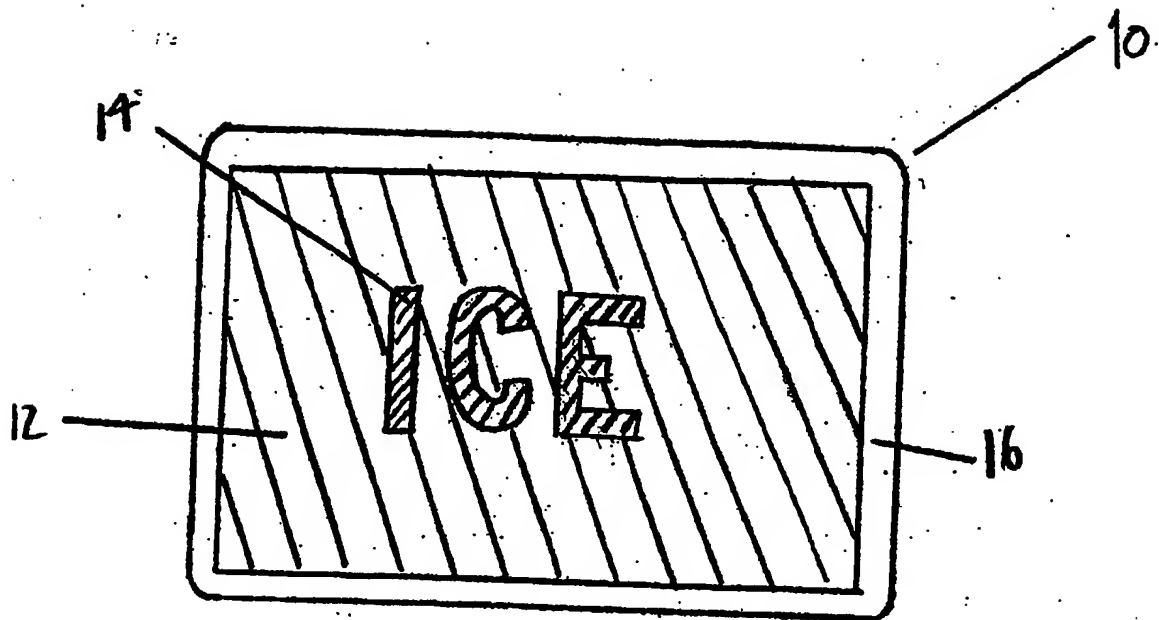


FIGURE 2a

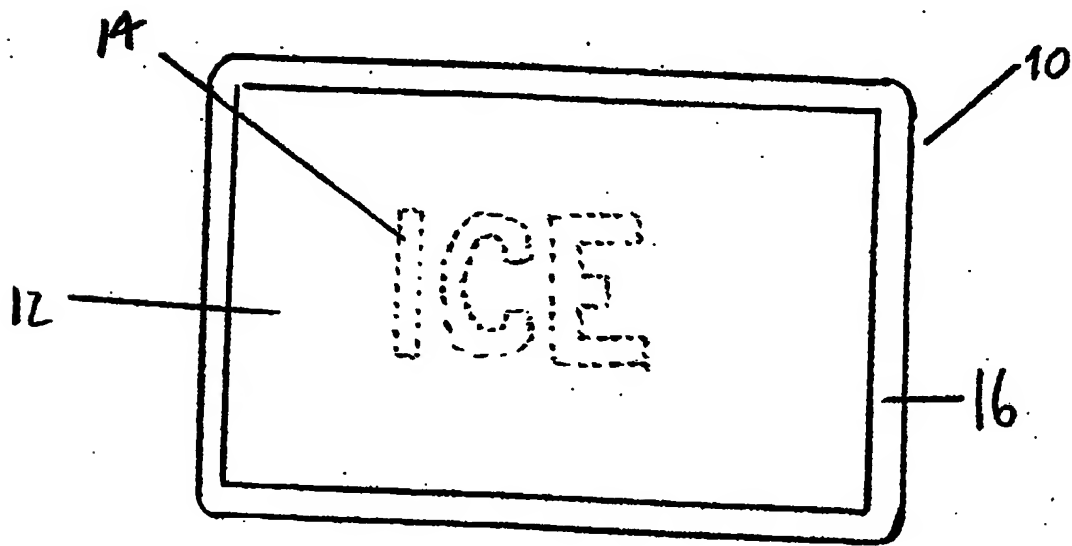


FIGURE 2b

1 **TEMPERATURE SENSITIVE SIGNS**

2

3 The present invention relates to the field of temperature
4 sensitive indicators and signs, and in particular
5 temperature sensitive road signs.

6

7 Signs and indicators for displaying information about
8 changing weather conditions have been known for some
9 time. For example, displays based on matrices of light-
10 emitting elements, such as filament emitters or LEDs are
11 commonplace at roadsides or across motorways. These
12 displays work in conjunction with a remote centre, which
13 controls the information displayed according to data on
14 the weather or driving conditions. Alternatively, the
15 displays may be provided with their own sensing stations
16 for the control of the information displayed.

17

18 The matrix displays above are expensive to produce and
19 maintain, and they have additional problems in that they
20 require a power source, as well as means for controlling
21 the information displayed according to locally-sensed
22 data or signals received from a remote centre.

23

1 Simpler means for displaying changes in weather
2 conditions have also been devised. For example, GB
3 2,289,707 discloses road markings and signs that can
4 indicate the incipient freezing of road surfaces. WO
5 84/00231 discloses an ice warning sensor with a
6 temperature sensitive reflective element.

7

8 However, the above display arrangements rely on liquid
9 crystals for their metachromic properties. Liquid
10 crystals are not ideally suited to these uses for a
11 number of reasons. Firstly, they are not particularly
12 adaptable. That is, the colours and temperature at which
13 the changes take place cannot be chosen, but are
14 determined by the properties of the liquid crystal
15 itself. Thus, if new properties are required, a new
16 liquid crystal must be synthesised. Secondly, liquid
17 crystals are readily degraded by coming into contact with
18 other compounds. In addition, it is often only possible
19 to obtain colours of a dark hue. Furthermore, liquid
20 crystals are expensive.

21

22 It would therefore be desirable to have means for
23 displaying a message to road users upon a change of
24 temperature, based on compounds other than liquid
25 crystals.

26

27 According to a first aspect of the invention there is
28 provided a display comprising: a first region and a
29 second region, the first region having a first colour and
30 the second region having a thermochromic paint applied
31 thereto, the colour of said thermochromic paint changing
32 from a second colour to a third colour at a temperature
33 threshold, wherein the thermochromic paint does not
34 comprise liquid crystals.

1 Preferably, the thermochromic paint displays the second
2 colour above the temperature threshold, and the third
3 colour below the temperature threshold,

4

5 The thermochromic paint may comprise one or more organic
6 compounds.

7

8 The thermochromic paint may comprise:

- 9 (i) one or more electron donating chromatic organic
10 compounds;
- 11 (ii) one or more compounds having a phenolic hydroxyl
12 group; and
- 13 (iii) one or more compounds selected from the group of
14 higher aliphatic monovalent alcohols.

15

16 Optionally, a fourth compound may be provided, being:

- 17 (iv) a compound selected from the group consisting of
18 higher aliphatic monovalent acid alcohol esters.

19

20 The display may be in the form of a road sign. The
21 temperature threshold may be in the range -5°C to 5°C .

22 Preferably, the temperature threshold is in the range -1°C
23 to 1°C .

24

25 Either the second colour or the third colour may be the
26 same as the first colour.

27

28 The second region may be in the shape of a written
29 message. Alternatively, or in addition, the second
30 region may be in the shape of a logo or motif.

31

32 The first region may also be coated with a thermochromic
33 paint, wherein the thermochromic paint changes colour
34 from a first colour to a fourth colour at a temperature

1 threshold. Preferably, the first colour and the second
2 colour are both the same, and the third colour and the
3 fourth colour are contrasting colours.

4

5 The display may be provided on a board made of a material
6 with high thermal conductivity. The display may
7 additionally be provided with a transparent coating.
8 Means for illuminating the display may be provided.

9

10 An example embodiment of the invention will now be
11 illustrated with reference to the following Figures in
12 which:

13

14 Figure 1a shows a sign at a temperature below T°
15 according to an embodiment of the invention.

16

17 Figure 1b shows the same sign at a temperature above
18 T° .

19

20 Figure 2a shows a sign at a temperature below T°
21 according to an alternative embodiment of the
22 invention.

23

24 Figure 2b shows a sign at a temperature above T°
25 according to an alternative embodiment of the
26 invention.

27

28 Figures 1a show and 1b show a sign, generally depicted at
29 10, comprising a board made up of a plurality of
30 laminated sheets. The board comprises a backing sheet of
31 a material with a high thermal conductivity, an
32 intermediate sheet of a first colour, and a transparent
33 top sheet. The high thermal conductivity of the backing
34 sheet results in an even temperature across the board. A

1 border 16 of reflective material surrounds the sign, and
2 illuminating means (not shown) is provided.

3

4 The intermediate sheet is divided into a first region 12
5 and a second region 14. The first region 12 is uncoated,
6 except for the transparent top sheet, and shows the first
7 colour, which is white in this embodiment. Second region
8 14 is shaped in the form of the legend "ICE", and is
9 coated with a thermochromic paint.

10

11 The thermochromic paint is one that does not contain
12 liquid crystals, and is selected to change colour at a
13 temperature threshold T° . Threshold T° is determined by
14 the chemical properties of the thermochromic paint, and
15 in this embodiment is set to be around 0°C . The colours
16 of the thermochromic paint are also determined by its
17 chemical make-up. In this embodiment, the second region
18 14 is colourless at a temperature above T° , and a dark
19 colour at a temperature below T° .

20

21 The sign is placed by a roadside, and when the air
22 temperature falls below T° , the thermochromic paint
23 changes to the dark colour, and the second region becomes
24 visible on the sign.

25

26 In this way, a warning message is displayed when the
27 temperature falls to around 0°C , alerting a road user that
28 ice may be forming on the road surface.

29

30 The thermochromic paint used is for example of the type
31 described in US Patent document 4,028,118, the contents
32 of which are incorporated herein by reference. These
33 thermochromic paints comprise the following components

- 1 (i) one or more electron donating chromatic organic
2 compounds;
3 (ii) one or more compounds having a phenolic hydroxyl
4 group; and
5 (iii) one or more compounds selected from the group of
6 higher aliphatic monovalent alcohols.

7

8 Optionally, a fourth component may be provided, being:

- 9 (iv) a compound selected from the group consisting of
10 higher aliphatic monovalent acid alcohol esters.

11

12 US 4,028,118 describes how the properties of the
13 thermochromic paint can be varied by changing the
14 formulation of the paint. Specifically, component (i)
15 determines the colour of the paint, component (ii) causes
16 the colour to change, and the temperature threshold is
17 caused by the amount of and type of components (iii) and
18 (iv).

19

20 Figures 2a and 2b show a road sign according to another
21 embodiment. Again, figure 2a shows the sign at a
22 temperature below T° , and figure 2b shows the same sign at
23 a temperature above T° .

24

25 In this embodiment, the first region 12 is coated with a
26 second thermochromic paint. This paint is selected so
27 that it changes colour at the same temperature threshold
28 as the first paint, but changes to a different colour.
29 For example, the thermochromic paint in the second region
30 is colourless at a temperature above T° , and blue at a
31 temperature below T° . The thermochromic paint in the first
32 region is also colourless at a temperature above T° , but
33 is red at a temperature below T° .

1

2 In this arrangement, the sign is white and displays no
3 message to road users at temperatures above T° . When the
4 temperature drops to below the threshold T° , the first
5 region and the second region both change colour to
6 contrasting shades. This improves the contrast of the
7 legend, making the warning clearer to road users.

8

9 If the low temperature colour in the first embodiment is
10 sufficiently dark, for example black, then the warning
11 will be clearly displayed against the white background.
12 However, in certain circumstances it may be advantageous
13 to use a different paint in the second region, such as
14 blue. For example, a thermochromic paint that changes
15 from colourless to black may be more difficult or more
16 expensive to produce than a slightly lighter hue.
17 Alternatively, a black paint might be less stable than a
18 lighter shade. The second embodiment allows the use of
19 lighter shades without comprising the legibility of the
20 warning message.

21

22 Further arrangements are envisaged. For example, any
23 message or warning can be displayed by the sign.
24 Alternatively, the second region may be shaped as a logo
25 or diagram instead of, or in addition to, the legend. In
26 addition, alternative colours may be used other than
27 those described above. In another arrangement, only the
28 first region is coated with the thermochromic paint, so
29 that the background changes colour instead of the
30 lettering in the described embodiment.

31

32 It is also possible to alter the threshold temperature to
33 any suitable temperature. For example, it may be found
34 that the temperature of the road surface is out of step

1 with the temperature of the sign, and therefore the
2 display will be required to change at a temperature a few
3 degrees above or below 0°C. For example, the illuminating
4 means may heat the sign to a certain extent. By changing
5 the chemical constituents of the paint, the threshold
6 temperature can be adjusted to a suitable level.

7
8 The present invention provides means for providing
9 temperature-sensitive warning messages cheaply and simply
10 to road users, without relying on liquid crystal
11 materials.

12
13 Further modifications and improvements may be
14 incorporated without departing from the scope of the
15 invention herein intended.

1 Claims

2

3 1. A display comprising: a first region and a second
4 region, the first region having a first colour and
5 the second region having a thermochromic paint
6 applied thereto, the colour of said thermochromic
7 paint changing from a second colour to a third
8 colour at a temperature threshold, wherein the
9 thermochromic paint does not comprise liquid
10 crystals.

11

12 2. A display as claimed in Claim 1 wherein the
13 thermochromic paint displays the second colour
14 above the temperature threshold, and the third
15 colour below the temperature threshold,

16

17 3. A display as claimed in Claim 1 or Claim 2 wherein
18 the thermochromic paint comprises one or more
19 organic compound.

20

21 4. A display as claimed in any preceding Claim wherein
22 the thermochromic paint comprises:

23 (i) one or more electron donating chromatic
24 organic compounds;

25 (ii) one or more compounds having a phenolic
26 hydroxyl group; and

27 (iii) one or more compounds selected from the group
28 of higher aliphatic monovalent alcohols.

29

30 5. A display as claimed in Claim 3 wherein the
31 thermochromic paint further comprises a compound
32 selected from the group of higher aliphatic
33 monovalent acid alcohol esters.

34

- 1 6. A display as claimed in any preceding Claim,
2 wherein the display is in the form of a road sign.
3
- 4 7. A display as claimed in any preceding Claim wherein
5 the temperature threshold is in the range -5°C to
6 5°C .
7
- 8 8. A display as claimed in any preceding Claim wherein
9 the temperature threshold is in the range -1°C to
10 1°C .
11
- 12 9. A display as claimed in any preceding Claim wherein
13 the second colour is the same as the first colour.
14
- 15 10. A display as claimed in any preceding Claim wherein
16 the third colour is the same as the first colour.
17
- 18 11. A display as claimed in any preceding Claim wherein
19 the second region is in the shape of a written
20 message.
21
- 22 12. A display as claimed in any preceding Claim wherein
23 the second region is in the shape of a logo or
24 motif.
25
- 26 13. A display as claimed in any preceding Claim wherein
27 the first region is coated with a thermochromic
28 paint, and the thermochromic paint changes colour
29 from a first colour to a fourth colour at a
30 temperature threshold.
31
- 32 14. A display as claimed in Claim 12 wherein the first
33 colour and the second colour are both the same, and

1 the third colour and the fourth colour are
2 contrasting colours.

3

4 15. A display as claimed in any preceding Claim wherein
5 the display is provided on a board made of a
6 material with high thermal conductivity.

7

8 16. A display as claimed in any preceding Claim wherein
9 the display is provided with a transparent coating.

10

11 17. A display as claimed in any preceding Claim wherein
12 the display is provided with means for illuminating
13 the display.



INVESTOR IN PEOPLE

Application No: GB 0204847.8
Claims searched: 1-17

12

Examiner: Charles Jarman
Date of search: 15 July 2002

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.T): E1G (GLB), G5C (CDBX, CJE)
Int Cl (Ed.7): E01F, G09F
Other: Online: WPI, PAJ, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	GB 2289707 A (WARD) See whole document.	6
X,Y	US 5503583 (HIPPELY ET AL) See column 5, line 49 - column 6, line 3 particularly.	X:1,2,7-12 Y:3-6, 13,15
X,Y	US 5202677 (PARKER ET AL) See e.g. column 2, lines 3-9 and column 7, lines 37-42.	X:1,2,7-12 Y:3-6, 13,15
Y	US 4142782 (O'BRIAN) See whole document.	13,15
Y	US 4028118 (NAKASUJI ET AL) See particularly column 31, line 66 - column 33, line 2.	3,4,5
Y	JP 8022259 A (ANZEN KK ET AL) See whole document.	6

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.